Landsat Science Team

Landsat Operations Report

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U.S. Department of the Interior
U.S. Geological Survey

Agenda

- L7 Status
- L8 Status

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Spacecraft Status: Summary

≈ 15 years of on-orbit operations

Batteries
•Performance nominal

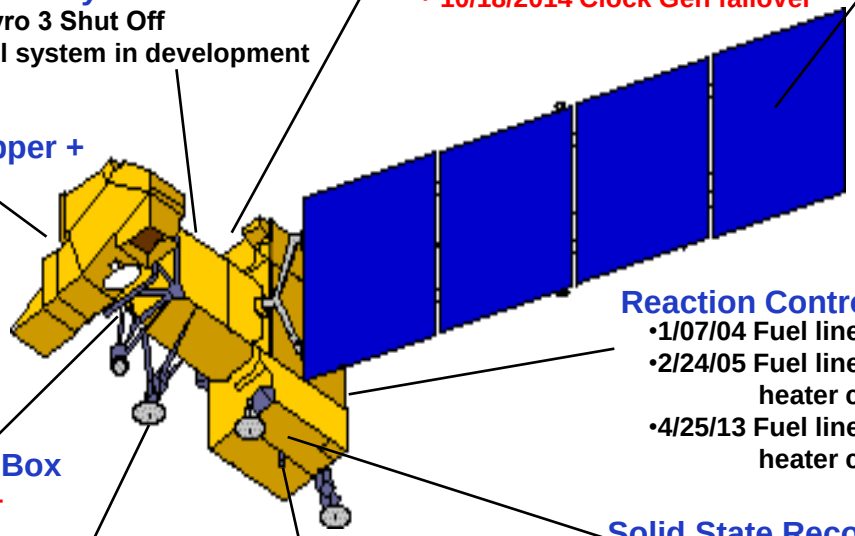
Power Subsystem

Solar Array
•5/14/2002 Circuit #14 Failure
•5/16/2005 Circuit # 6 Failure
•8/13/2008 Circuit #14 partial recovery
•14 circuits remain operating
•no impact to ops

Power Control Unit
• 10/18/2014 Clock Gen failover

Attitude Control System
•05/05/2004 Gyro 3 Shut Off
•1-gyro control system in development

Enhanced Thematic Mapper +
•5/31/2003 SLC Failure
•4/01/2007 Bumper mode



Reaction Control System
•1/07/04 Fuel line #4 thermostat #1a failure
•2/24/05 Fuel line #4 thermostat failure; Primary heater circuit disabled
•4/25/13 Fuel line #2 thermostat failure; Redundant heater circuit disabled

Remote Tlm Cmd (RTC) Box
•09/27/2014 RTC A Failover

Solid State Recorder
•11/15/1999 SSR PWA #23 Loss
•02/11/2001 SSR PWA #12 Loss
•12/07/2005 SSR PWA #02 Loss
•08/02/2006 SSR PWA #13 Loss
•03/28/2008 SSR PWA #22 Loss
•09/03/2008 SSR PWA #23 Recovered
•10/12/2013 SSR PWA #11 Loss
•Each PWA is 4% loss of launch capacity
•Boards are likely recoverable

X-band System
Performance nominal

S-band System
Performance nominal

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Landsat 7 Attitude Control Issues

- **PRADS Resets**
  - **Investigation showed that issue is seasonal due to sparse star catalog**
  - **Four occurences**
    - **9/17/2014** **single reset**
    - **9/21/2015** **two resets**
    - **10/3/2014** **single reset**

- **Reduced Gyro**
  - **Limited on-board processing for computations**
  - **New 'sparse' processing code delivered and currently being integrated into flight software code. Code is also being scrutinized to see if additional savings in computational load can be found.**
  - **2 new simulator versions were delivered with updates to the code**
  - **Flight software engineer engineer is working on integrating newest code into flight software and performing testing**

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Landsat 7 Anomalies

- **Landsat 7 RTC Anomaly**
  - **On 27 Sep 2014 there were power issues with the primary Remote Telemetry and Command Unit (RTC) and automatically switched to the redundant RTC**
  - **RTC is a command and telemetry routing box**

- **Landsat 7 BVR Anomaly**
  - **On 18 Oct 2014 telemetry indicated that a clock generating circuit for the Boost Voltage Regulator (BVR) in Power Control Unit (PCU) switched from the primary to the redundant**
  - **Bus Voltage Regulator (BVR) discharges the batteries to boost the bus voltage**

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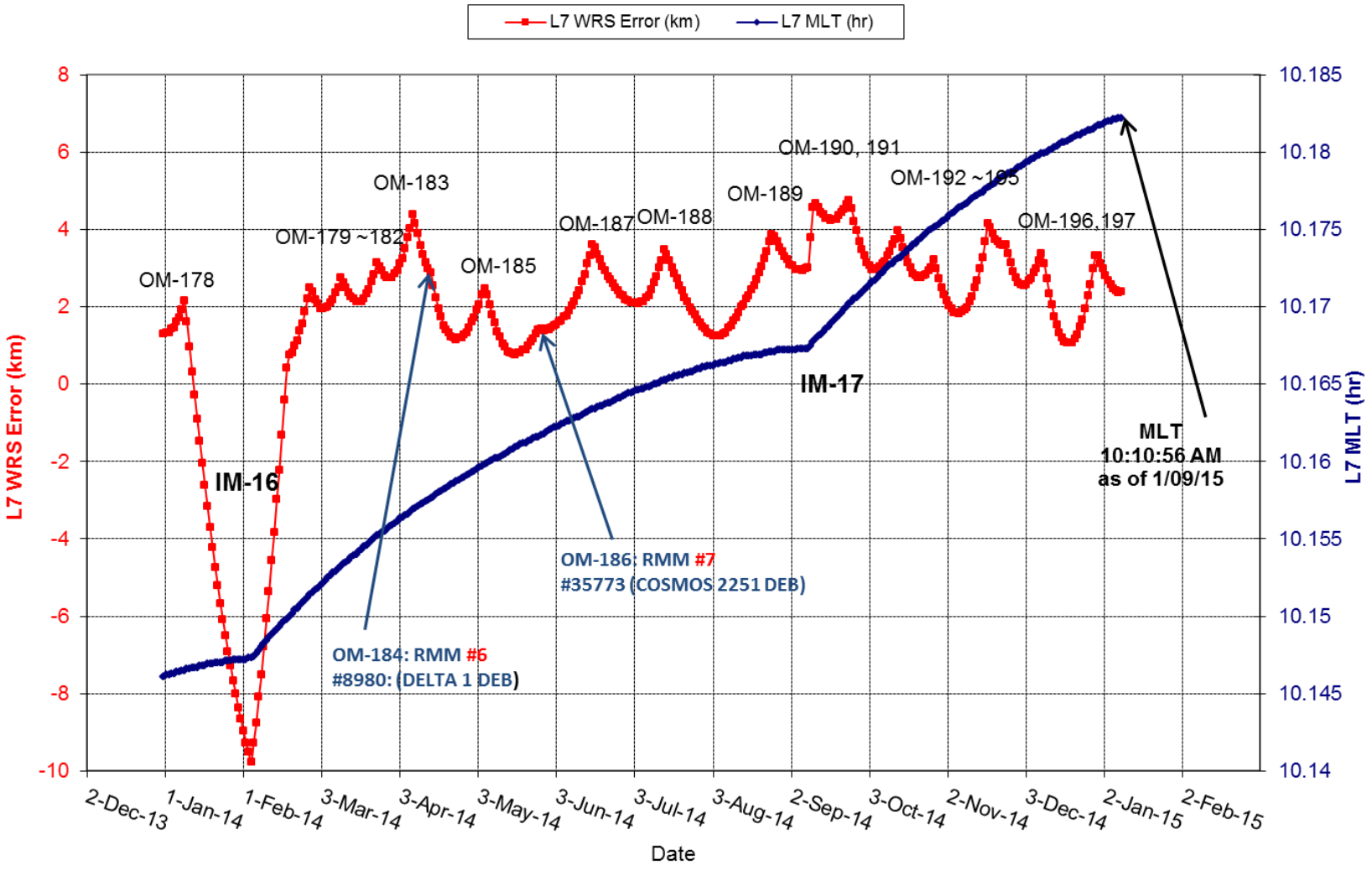
Current L7 WRS Error and MLT



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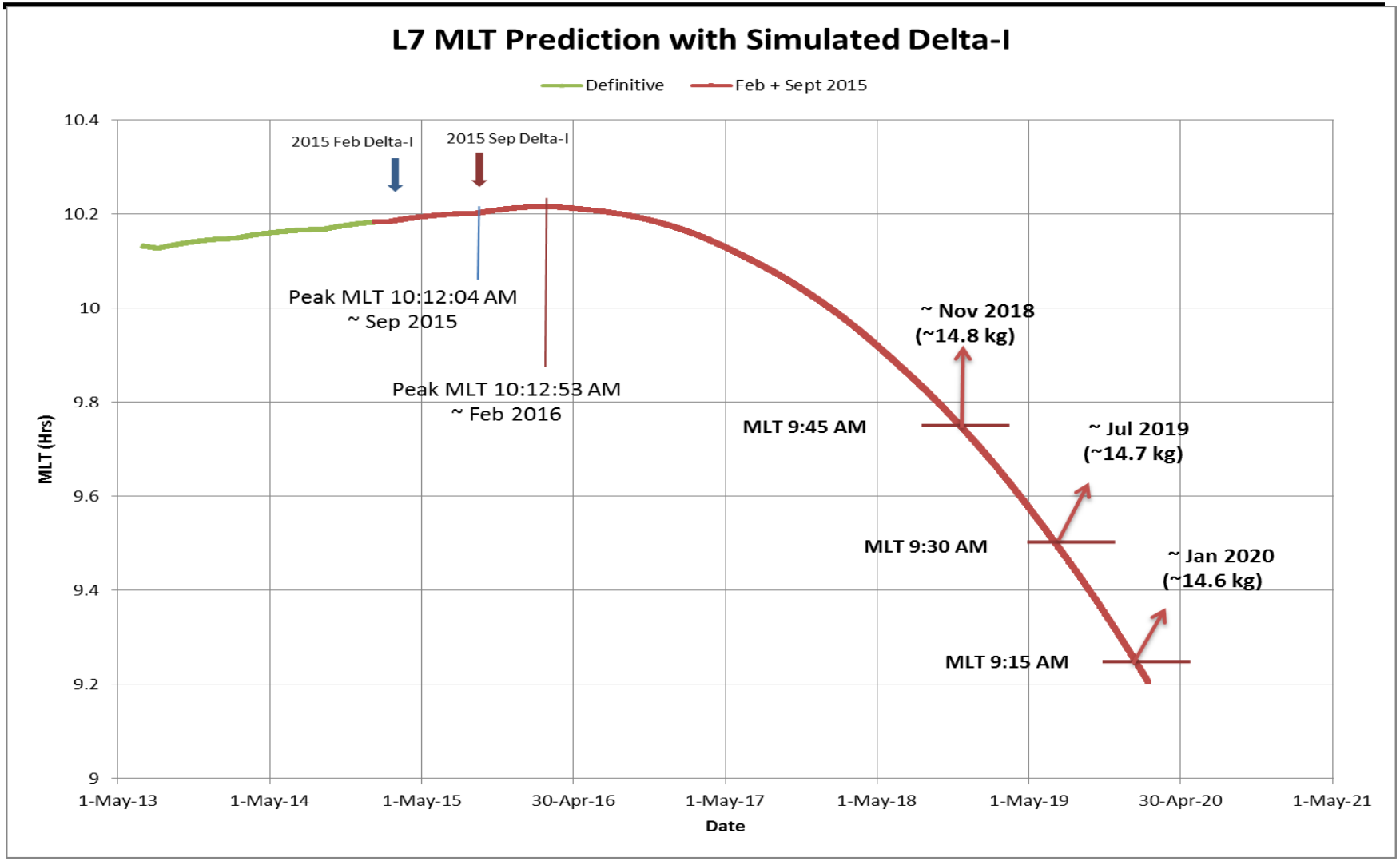
L7 MLT Prediction



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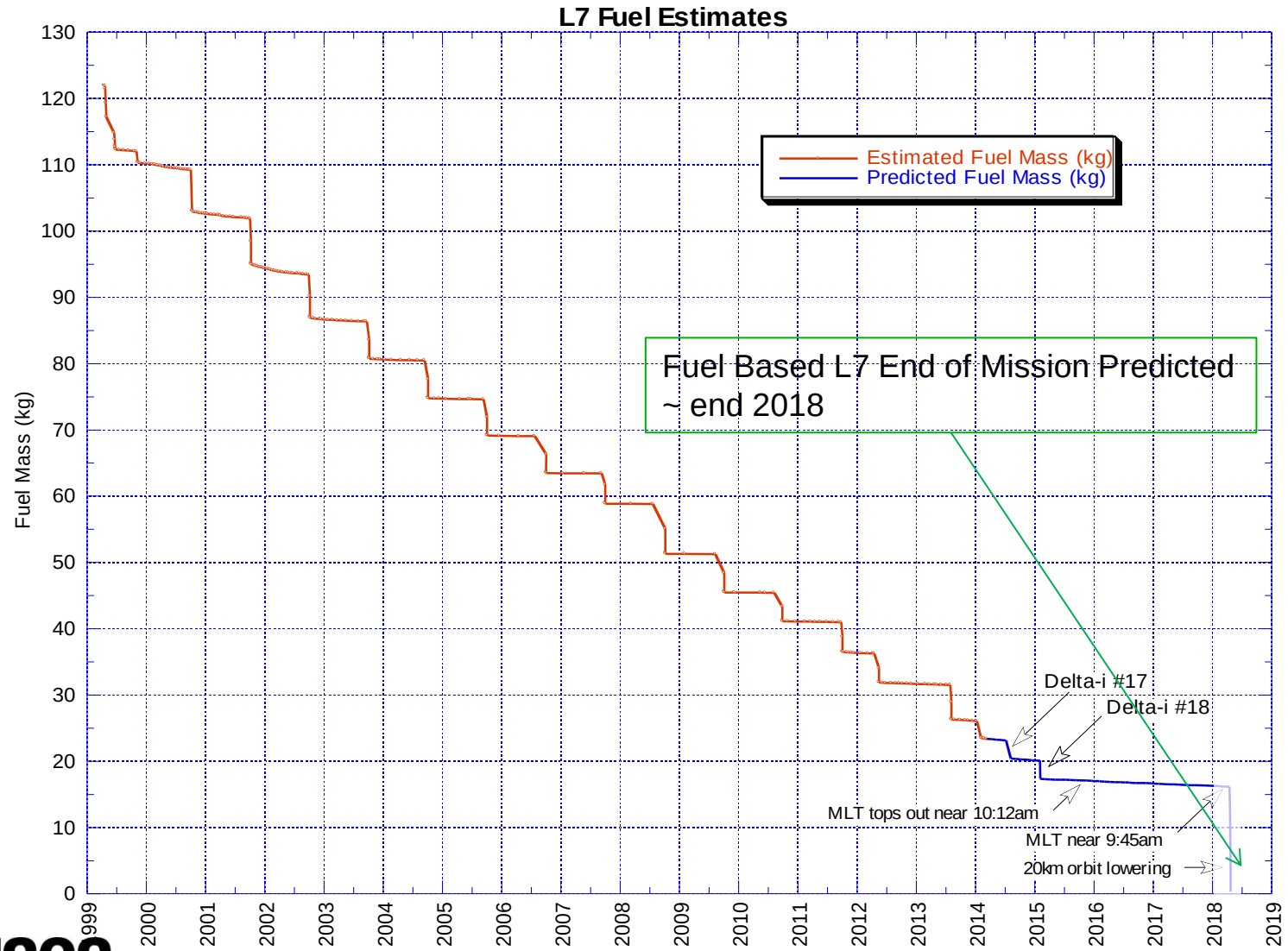
Landsat 7 Fuel Usage and Prediction



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Landsat 8 Spacecraft Status

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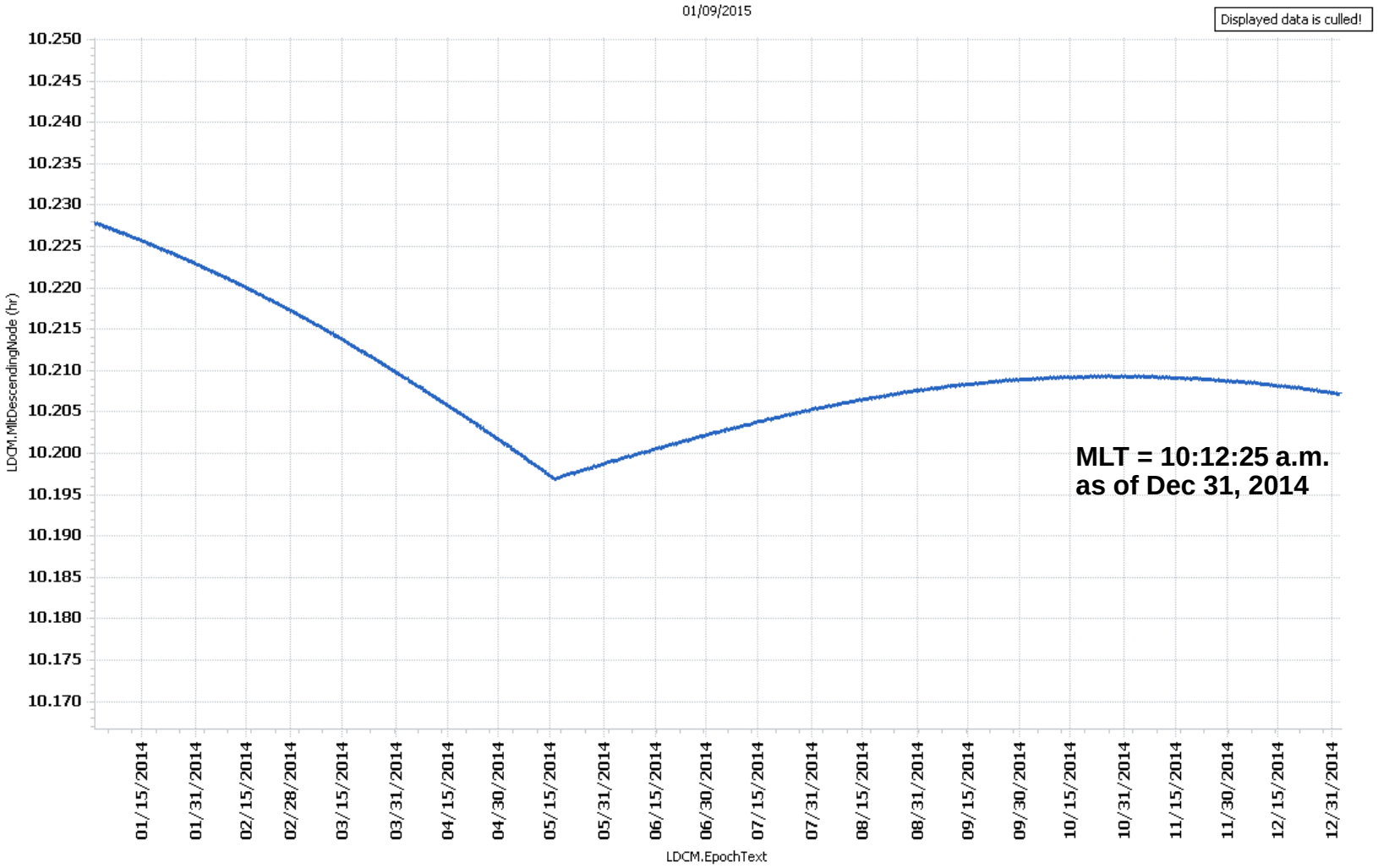
Landsat 8 MLT

Jan 1, 2014 through Dec 31, 2014



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Landsat 8 Image Collection Rate Increase

- **Goal: determine the Number of Landsat 8 Images Per Day**
  - **Landsat science community requests increased acquisition of sun-lit land images beyond the current average of 550 scenes/day**
  - **Current "budget" also includes**
    - **Night requests 6 images/night or 2 paths (volcano, special, and calibration requests)**
    - **Ocean campaigns average 25 images per day**
  - **In addition to the 550 an average 30/day flywheel scenes are collected for increased efficiency**
  - **Ascending sun-lit rows (~164 images/day potential) excluded – special requests accepted**
  - **Up to average of 550 scenes per day has been demonstrated as supportable since June 2013**
  - **Impact on satellite and satellite component life is negligible**
  - **Impact on Ground System is minor**
- **Result**
  - **Incrementally increased collection rate to nominally 725 scenes/day**
  - **Decision to remain at 725 scenes/day 11/13/2014**

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TIRS SSM Encoder Summary

- **In the fall of 2014 a deviation in a Mechanism Control Electronics (MCE) current was noted. Over the first year of the mission the MCE current had been stable, however starting mid-2014 the current had begun to display a noisy signature.**
- **Beginning in October 2014 a steady unexpected increase in current magnitude was observed. (see next slide)**
- **An Anomaly Resolution Board (ARB) was convened to determine the root cause and assess any hazard to the TIRS instrument.**
- **Based on thermal and current trends, electronics in the TIRS encoder are not behaving as expected. There has been no observed degradation in the performance of the instrument.**
- **Prior to launch the MCE current limits were defined based on predicted nominal circuitry degradation. The yellow limit was revised to a higher absolute threshold (from -0.075 A to -0.08 A) as the issue progressed and that threshold was reached on December 19, 2014.**
- **More information in afternoon session**

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Reference Information

Landsat 7 RTC Anomaly

- On 27 Sep 2014 Failure Detection and Correction (FDAC) software detected power issues with the primary Remote Telemetry and Command Unit (RTC) and automatically switched to the redundant RTC
- RTC is a command and telemetry routing box
  - Determine cause
    - In-depth study of telemetry and trends
    - Reach out to other missions using similar equipment from manufacturer
  - Failure of RTC or single event
    - Determine whether or not this represents a loss of redundancy
- Science data downlinks suspended for two days while ensuring spacecraft health & safety and preliminary investigation
- Three onboard stored command sequences used for safing the s/c in an attitude or power anomaly were made INVALID so they could not be executed by FSW. These sequences will be changed on the ground, reloaded, and made VALID again to fully restore the onboard safing mechanisms.
- Working on changes to the onboard FSW FDAC configuration are expected in response to the new hardware configuration.

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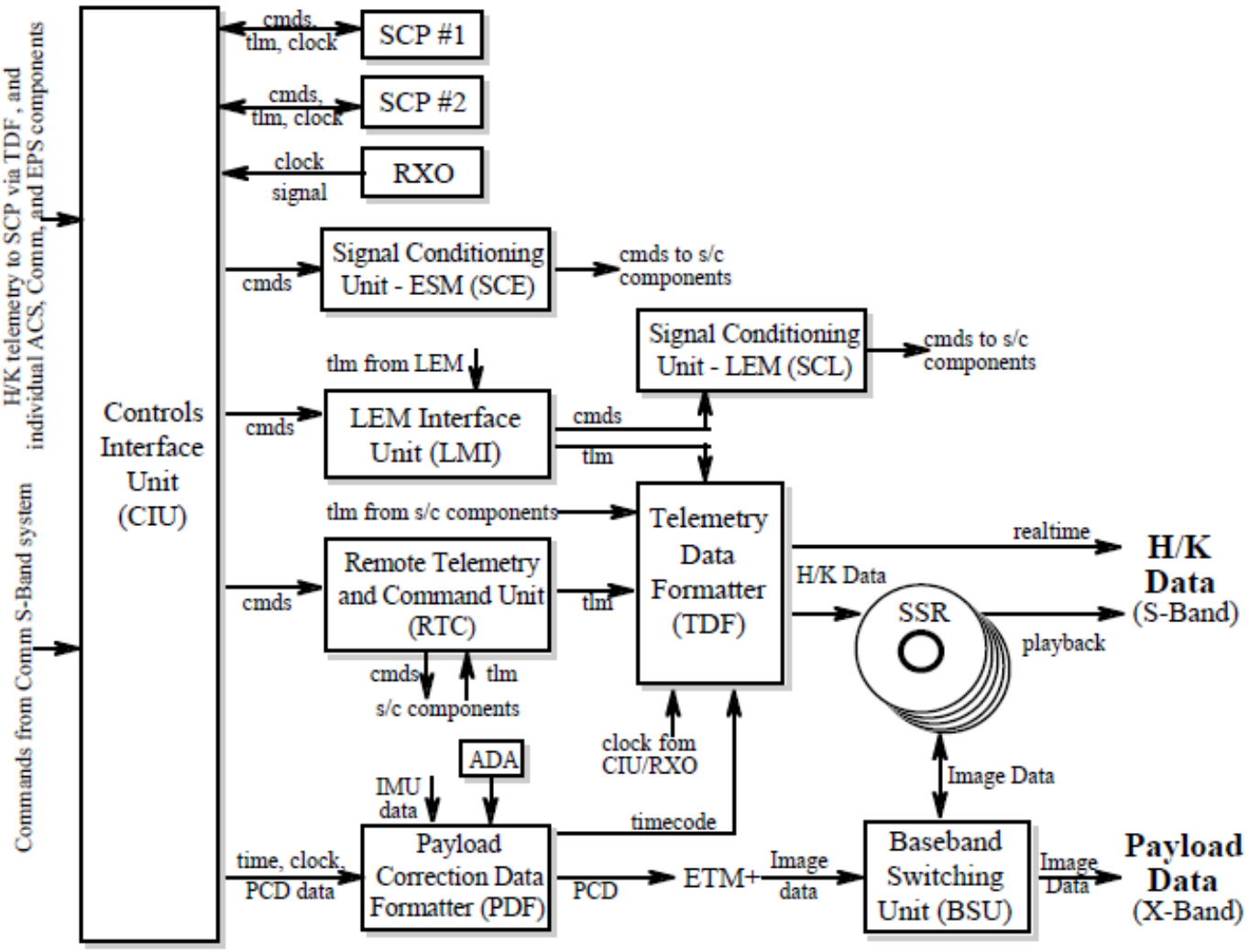
Landsat 7 Telemetry & Command Flow



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Landsat 7 BVR Anomaly

- On 18 Oct 2014 telemetry indicated that a clock generating circuit for the Boost Voltage Regulator (BVR) in Power Control Unit (PCU) switched from the primary to the redundant
  - The PCU regulates the spacecraft bus to 28± 0.56 volts by battery charging, discharging and shunting solar array power.
  - The control devices internal to the PCU are:
    - Battery Charge Regulator (BCR) - a V/T controlled charger for the batteries
    - **Bus Voltage Regulator (BVR) - discharges the batteries to boost the bus voltage**
    - Mode Controller (MC) - operates the BCR, BVR, and Shunt Drive Assembly (SDA) to maintain the 28V bus regulation.
- No interruption to operations and no response from FOT was necessary
- No indication of faults in telemetry prior to switch and no change to any telemetry after change (except circuit Prime/Backup indicator)
- This switch is currently under investigation

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Landsat 7 Data Loss

- July 106 scenes
- Aug 113 scenes
- Sep 172 scenes
- Oct 123 scenes
- Nov 218 scenes
  - Australian station (ASN) scheduling system issue
  - Norwegian (SG) station software fault
- Dec 127 scenes
- All due to various expected ground station issues

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